# CHARACTERISTICS AND COMMON VULNERABILITIES INFRASTRUCTURE CATEGORY: HYDROELECTRIC DAMS

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Department of Homeland Security

Version 1 January 15, 2004

*Preventing terrorism and reducing the nation's vulnerability to terrorist acts require understanding the common vulnerabilities of critical infrastructures, identifying site-specific vulnerabilities, understanding the types of terrorist activities that likely would be successful in exploiting those vulnerabilities, and taking preemptive and protective actions to mitigate vulnerabilities so that terrorists are no longer able to exploit them. This report characterizes and discusses the common vulnerabilities of hydroelectric power facilities.*

## HYDROELECTRIC DAM CHARACTERISTICS

### Industry Profile

Hydropower, including pumped storage, constitutes about 14% of the electrical generating capacity of the United States (U.S.). Hydropower is the primary source of renewable energy in the U.S. Total U.S. hydroelectric capacity is 103.8 gigawatts (GW), including pumped storage projects. The federal government owns 38.2 GW at 165 sites (excluding pumped storage). Another 40 GW of non-federal, licensed conventional hydroelectric capacity (excluding pumped storage) exists at 2,162 sites in the U.S. (National Hydropower Association). The distribution of hydropower generating capacity by ownership is illustrated in Figure 1. The 10 largest hydroelectric facilities in the country are listed in Table 1 (U.S. Society on Dams).

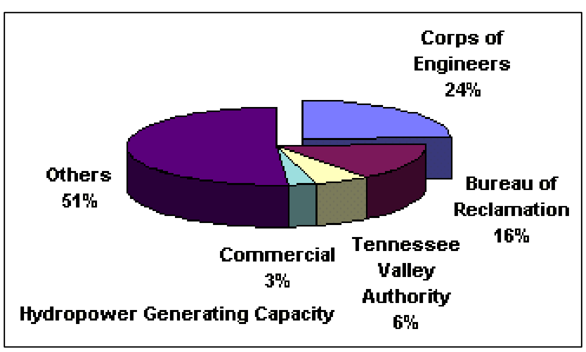


**Figure 1 Distribution of Hydropower Generating Capacity (USACE)**

**Table 1 Largest Hydro Projects in the United States**

| Dam Name | River | Location | MW |
|---|---|---|---|
| Grand Coulee | Columbia | Washington | 6180 |
| Chief Joseph | Columbia | Washington | 2457 |
| John Day | Columbia | Oregon | 2160 |
| Bath County P/S | Little Back Creek | Virginia | 2100 |
| Robert Moses - Niagara | Niagara | New York | 1950 |
| The Dalles | Columbia | Oregon | 1805 |
| Luddington | Lake Michigan | Michigan | 1657 |
| Raccoon Mountain | Tennessee River | Tennessee | 1530 |
| Hoover | Colorado | Nevada | 1434 |
| Pyramid | California Aqueduct | California | 1250 |
| Source: *USSD Register of Dams* | | | |

Federal ownership of hydroelectric facilities is concentrated in the U.S. Army Corps of Engineers (USACE), the U.S. Bureau of Reclamation (USBR), and the Tennessee Valley Authority (TVA).

The USACE is the largest hydropower producer, with 375 generating units and a total rated capacity of 21 GW. Its largest producer is the Bonneville Dam on the Columbia River, with 286 megawatts (MW) of rated capacity. Most of the USACE hydropower capacity is concentrated in the Northwestern Division, which, in addition to Bonneville, has 14 other dams with more than 100 MW of rated capacity. (USACE Hydroelectric Design Center).

The USBR has somewhat less total hydropower capacity than USACE, with a total of 14.8 GW produced at 58 hydroelectric plants. The bulk of USBR's hydroelectric capacity, however, is concentrated in a few large dams. More than two-thirds is accounted for by the top three dams: Grand Coulee (6.8 GW), Hoover (2 GW), and Glen Canyon (1.3 GW).

The TVA maintains 29 conventional hydroelectric dams throughout the Tennessee River system and 1 pumped-storage facility for the production of electricity. TVA hydroelectric facilities have a total capacity of about 5 GW. Its largest facility is the Raccoon Mountain pumped storage reservoir with 1.5 GW of capacity. Altogether, TVA operates 15 dams with more than100 MW of hydroelectric generating capacity. In addition, 4 Alcoa dams on the Little Tennessee River and 8 Corps of Engineers dams on the Cumberland River contribute to the TVA power system.

Most non-federal hydroelectric dams are operated by power companies and are licensed by the Federal Energy Regulatory Commission (FERC). FERC listed 1,010 licensed hydroelectric facilities in 2001 (FERC). Fourteen of the licensed facilities are 1 GW or more in size, with the largest (2.75 GW) being the Niagara facility owned by New York Power Authority. Table 2 shows the 14 largest-capacity hydroelectric facilities licensed by FERC in 2001.

Actual generation supplied by hydropower facilities varies from year to year depending on rainfall and other factors, but it is generally somewhat less than 10% of the total for the U.S. For example, in 1999, hydropower supplied 8.5% of the electricity generated in the U.S. and 7.2% in 2000. In some states, however, it is a much higher percentage, primarily in the western part of the country. Table 3 shows the 10 states most reliant on hydropower production in the year 2000 (U.S. Energy Information Administration).

The hydroelectricity currently produced each year in the U.S. is equivalent to nearly 500 million barrels of imported crude oil. This total represents a value for existing hydrogeneration of about $9 billion annually. Hydropower generation does not produce atmospheric emissions, which are a growing problem on both national and global levels (USBR).

**Table 2 Non-Federal Hydroelectric Facilities Licensed by FERC in 2001 (Capacity of 1 GW or More)**

| Project Name | Capacity (MW) | FERC License | | State(s) | County(ies) | Water Source | Owner |
|---|---|---|---|---|---|---|---|
| | | Issued | Expires | | | | |
| Northfield Mountain | 1000.0 | 5/14/1968 | 4/30/2018 | MA | Franklin | Connecticut River | Connecticut Light and Power Co. |
| Blenheim Gilboa | 1000.0 | 6/6/1969 | 4/30/2019 | NY | Schoharie | Schoharie Creek | Power Authority, State of New York |
| Boundary | 1024.0 | 7/10/1961 | 9/30/2011 | WA | Pend Oreille | Pend Oreille River | Seattle City of WA |
| Helms | 1050.0 | 5/18/1976 | 4/30/2026 | CA | Fresno | NFK Kings River | Pacific Gas & Electric Co. |
| Bad Creek P S | 1065.0 | 8/1/1977 | 7/31/2027 | SC | Oconee | Bad Creek | Duke Power Division, Duke Energy Corp. |
| Hells Canyon | 1166.9 | 8/4/1955 | 7/31/2005 | ID, OR | Adams and Washington Counties in Idaho; Wallowa, Baker, and Malheur Counties in Oregon | Snake River | Idaho Power Co. |
| Rocky Reach | 1237.4 | 7/11/1957 | 6/30/2006 | WA | Douglas | Columbia River | Chelan Co., PUD 1 |
| Spokane River | 1366.0 | 8/17/1972 | 8/1/2007 | ID, WA | Spokane, Stevens, and Lincoln Counties in Washington; Kootenai and Benwah Counties in Idaho | Spokane River | Resources West Energy Corp. |
| Ludington | 1657.5 | 7/30/1969 | 6/30/2019 | MI | Mason | Lake Michigan | Consumers Power Co. |
| California Aqueduct | 1679.1 | 3/22/1978 | 1/31/2022 | CA | Los Angeles | California Aqueduct West Branch (Piru Creek) | CA Dept of Water Resources |
| Priest Rapids | 1755.0 | 11/4/1955 | 10/31/2005 | WA | Grant | Columbia River | Grant Co. PUD 2 |
| Mount Hope Pumped Storage | 2000.0 | 8/4/1992 | 7/31/2042 | NJ | Morris | Mt Hope Lake | Mount Hope Waterpower Prj. L.P. |
| Bath County | 2100.0 | 1/10/1977 | 12/31/2026 | VA | Bath | Back Creek | Virginia Elec & Pwr Co. |
| Robert Moses-Niagara | 2755.5 | 1/30/1958 | 8/31/2007 | NY | Niagara | Niagara River | N.Y. Power Authority |

**Table 3  States Most Reliant on Hydropower Production in 2000**

| State | Hydropower Percentage of Electricity Production (%) |
|---|---|
| Idaho | 92 |
| Washington | 74 |
| Oregon | 74 |
| South Dakota | 59 |
| Montana | 42 |
| Maine | 29 |
| Vermont | 20 |
| California | 19 |
| New York | 18 |
| Alaska | 16 |

## Common Characteristics

Hydroelectric facilities come in many shapes and sizes; however, they all have certain features in common. A dam is built on a river to provide a reservoir of water that is at a higher elevation than the flow downstream. The potential energy of this water is released in a controlled fashion as the water is allowed to run from the reservoir through tunnels or pipes, referred to as penstocks, driving one or more turbines connected to generators. After driving the turbines, the water is released downstream. A gate is used to control the flow through the penstocks. Figure 2 illustrates the key features of a hydroelectric dam.

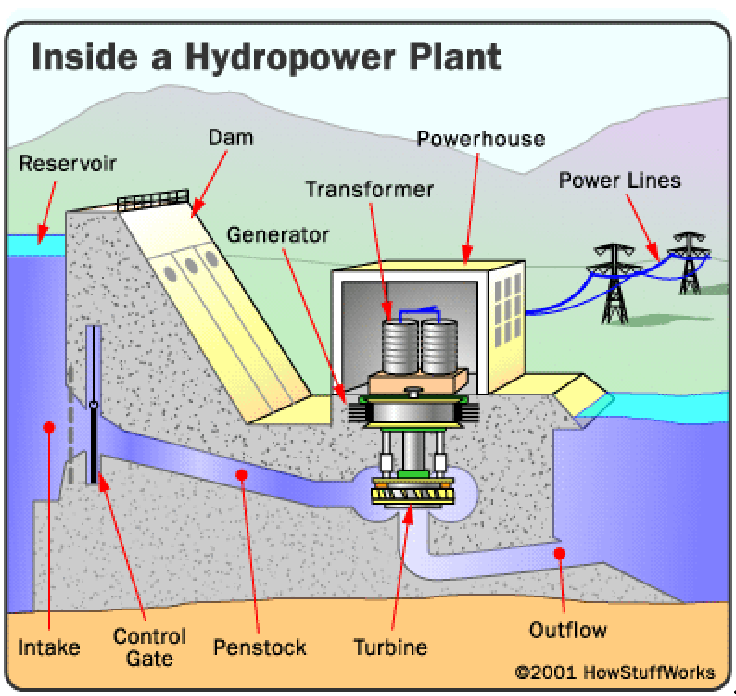


**Figure 2  Features of Hydroelectric Dam**

Larger hydroelectric dams have banks of turbines housed in one or more powerhouses. For example, Hoover Dam has a bank of 17 generators (see Figure 3). Grand Coulee Dam has a total of 33 generating units in four different powerhouses.

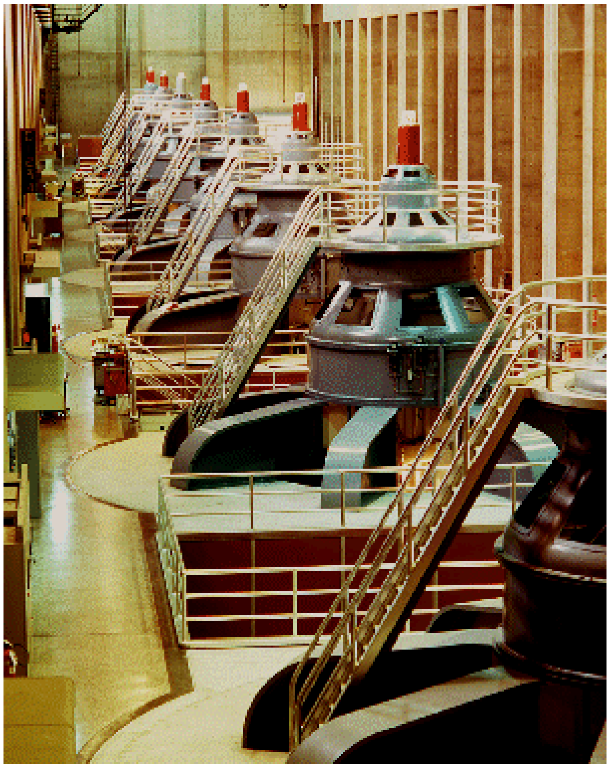

**Figure 3 Generators at Hoover Dam**

In addition to the facilities illustrated in Figures 2 and 3, hydroelectric dams typically have a way to release water from the reservoir in a controlled manner that bypasses the electricity-generating facility. This may be necessary to allow the turbines to be worked on, or to release extra water in times of flood or to maintain stream flow. The bypass may be in the form of additional penstocks or one or more spillways that allow water over the top of the dam. Flow through the bypasses is controlled via gates and valves. In general, each dam uses electromechanical devices to control water flow through the facility from a central control room using a supervisory control and data acquisition (SCADA) system.

Some hydroelectric facilities have a pumped-storage facility to store water for release as needed to meet electrical demand. A pumped-storage facility uses two reservoirs, one located at a higher elevation than the other. During periods of low demand for electricity, such as nights and weekends, energy is stored by reversing the turbines and pumping water from the lower to the upper reservoir. When electrical demand is high, the stored water can be released to turn the turbines and generate electricity as it flows back into the lower reservoir.

Many hydroelectric dams, especially the larger ones, have multiple missions. Besides producing electricity, they can provide:

- Water supply for human domestic consumption, industrial uses, and agricultural irrigation;
- Flood control and river navigation;
- A transportation link for vehicular traffic (across the top of the dam); and
- Water-based recreational uses (boating and fishing).

Particularly in the arid western U.S., the water supply and irrigation functions of larger dams can be significant. Grand Coulee Dam in eastern Washington State provides irrigation for more than half a million acres of the Columbia River Basin from Coulee City in the north to Pasco in the south. Lake Mead, the reservoir formed by the blocking of the Colorado River at Hoover Dam, at its maximum height covers 247 square miles with 28,537,000 acre-feet of water, equivalent to two years of average flow of the river. Water is apportioned from the Colorado River system per agreements and treaties to seven states and Mexico at a total allotment of 16.5 million acre-feet per year. Lake Mead is the primary source of domestic water for Las Vegas and is a major source for Los Angeles, San Diego, and other southern California communities, as well as for agricultural irrigation in southern California and Nevada.

Flood control is a key mission of essentially every dam. Failure of the flood control mission at a major hydroelectric dam is likely to lead to property damage and loss of life downstream (see Consequence of Event section below). Note that a flood control failure does not necessarily require a catastrophic failure of the dam; it can also result from manipulation or failure of the SCADA system or the gates and valves it operates, allowing more water than desired to exit the reservoir.

Dams are built according to well-documented engineering principles and regulated standards (see Standards section below). They are designed to withstand a variety of potential problems: inherent structural flaws; failure of materials used to construct the dam; aging and deterioration, failure of the land that supports the dam; cracking caused by earthquakes or the natural settling of the dam; inadequate monitoring and maintenance; sink holes in the dam; and excessive flooding and landslides. A well-built large dam is difficult to destroy; as remarked by Philip Anderson of the Center for Strategic and International Studies in Washington, D.C.: "Even in wartime, the military has a hard time breaking through the larger dams. It would be tremendously difficult for terrorists to carry enough explosives with them to destroy a large dam." [*News Journal*]

Dams typically have a lot of visitors. The reservoirs associated with hydroelectric dams are often recreational facilities that attract large numbers of persons for boating, fishing, and swimming. In some cases, the dam itself is considered a tourist attraction. In the year 2000, Hoover Dam recorded 1,276,292 visitors; in 2002, Glen Canyon Dam and Lake Powell had more than 2 million visitors(Friends of Lake Powell). The large number of visitors to these facilities can complicate security procedures.

## CONSEQUENCE OF EVENT

The consequences of disruption of a hydroelectric dam are highly dependent on the particular dam and on the particular circumstances of the event. Disruption of electrical generation or transmission equipment could lead to short- or long-term removal of the dam's electrical generating capacity. Some equipment could take months to replace. Local or regional electric power grids could be affected depending on demand and the size and duration of the supply disruption. About 20 hydroelectric plants have a capacity of 1 GW or more; the rest are smaller. For most larger hydroelectric facilities, removal of the facility from service would have an impact roughly equivalent to removal of a large- or moderate-sized fossil fuel or nuclear plant.

Because hydroelectric facilities generally serve multiple missions, their disruption can cause multiple effects. Besides loss of electrical generating capacity, effects can include loss of water supply for domestic and irrigation purposes, flooding, and damage to transportation facilities. As noted above, failure of the flood control mission of a dam can result from disruption or manipulation of the facility's control mechanisms, as well as from physical destruction of the dam.

While physical destruction of a landmark dam such as Hoover or Grand Coulee would be relatively difficult to accomplish, failure of smaller dams could also lead to loss of life and widespread property destruction. The Teton Dam failure in 1976 offers a case study (see Figure 4).

**Figure 4 Failure of Teton Dam in 1976**

Teton Dam, a USBR dam in Idaho, failed for reasons that were never fully characterized. It was a just-completed earthfill dam approximately 3,000 feet wide and 300 feet tall. Teton Reservoir, formed by construction of Teton Dam, was to provide a supplemental water supply to 111,210 acres of land in the Fremont-Madison Irrigation District, local and downstream flood control benefits, water to operate a 16,000-kilowatt powerplant, and major recreation developments. It was a moderate-size dam as USBR projects go. Teton Dam failed on June 5, 1976, when the reservoir, still filling, was within 20 feet of its design depth. Floodwaters coursed down the Teton River and then the Snake River; the flood was finally contained at the American Falls reservoir approximately 70 miles downstream. Nine lives were lost and 4,095 homes were destroyed along with 4,073 farm buildings. Other damage included 100,000 acres of farmland inundated, 427,000 acres of land left without irrigation, 252 businesses interrupted, 21 miles of railroad and 120 miles of vehicular road disrupted, and 250 miles of power line damaged or destroyed.

In an interview, Philip Anderson of the Center for Strategic and International Studies in Washington, D.C., said that along the East Coast, there are 25 dams “large enough to cause significant downstream damage in terms of loss of life and whose loss would cause a potential strain on the power grid.” [*News Journal*]

Failure of the flood control mission of one dam may compromise the operation of other dams downstream. Many rivers have multiple dams; for example, 4 of the 10 largest hydroelectric dams in the country are on the Columbia River. The lower portion of the Colorado River includes a total of 9 dams: the Glen Canyon, Hoover, Davis, Parker, Headgate Rock, Palo Verde, Imperial, Laguna, and Morales Dams. The downstream effect of a flood control failure at a particular dam would depend on the amount and rate of water released, characteristics of the intervening valley, characteristics of the dams below, and fill status of reservoirs below.

## STANDARDS

The regulatory structure for dams in the U.S. is divided between the federal government and the states. FERC regulates hydroelectric projects. The states regulate all non-federal dams, which accounts for approximately 94% of the dams in the country. Dams owned by federal agencies are self-regulated (Stanford). Therefore, a federally owned dam will be self-regulated by the agency that owns it; a non-federal hydroelectric dam will be subject to regulation by FERC and by the state(s) in which it is located.

For FERC-regulated dams, FERC regulates both the construction and operational phase of a project. Dam safety is a critical part of the Commission’s hydropower program and receives top priority. Before projects are constructed, the Commission staff reviews and approves the designs, plans, and specifications of dams, powerhouses, and other structures. During construction, Commission staff engineers frequently inspect a project, and once construction is complete, Commission engineers continue to inspect it on a regular basis.

FERC regulations pertaining to hydropower permitting are found in Title 18 of the *Code of Federal Regulations*. FERC dam safety guidelines and manuals, available on the FERC website, include Division of Dam Safety and Inspections Operating Manual, Engineering Guidelines for the Evaluation of Hydropower Projects, Guidelines for Public Safety at Hydropower Projects, and Dam Safety Performance Monitoring Program /Potential Failure Modes Analysis.

In 1920, Congress passed the Federal Water Power Act, which granted regulatory control to the Federal Power Commission — the predecessor to FERC. Since the original act was passed, several more significant pieces of legislation have come into effect, including the Federal Power Act, the Public Utility Regulatory Policies Act, the Electric Consumers Protection Act of 1986, and the Energy Policy Act of 1992. These acts set out strict guidelines for non-governmental hydropower plants located in the U.S., that affect navigation, that use water or water power at a government dam, and that affect interstate commerce. Currently, regulation is under FERC's control and is conducted in accordance with the standards outlined in these policies. FERC's responsibilities include issuing preliminary permits; granting exemptions; issuing project licenses valid for a period of 30–50 years; conducting safety inspections; relicensing; coordinating with other agencies; conducting project compliance activities; and investigating and assessing payments for headwater. Currently, FERC is responsible for dam safety at about 2,600 licensed and exempted dams and water retention facilities. FERC engineers stationed around the country conduct regular comprehensive safety inspections at all licensed dams (Hollett).

The National Dam Safety Program Act (Public Law 104-303, Section 215) provides for inspection of dams by the U.S. Army Corps of Engineers. The Act exempts dams owned by the USBR, TVA, or the U.S. International Boundary and Waters Commission, and also exempts dams licensed by FERC. However, it provides that any federal agency that owns a dam must cooperate with state dam safety inspection agencies. On request of a state dam safety agency, with respect to any dam, the failure of which would affect the state, the head of a federal agency must either provide information to the state dam safety agency on the construction, operation, or maintenance of the dam, or permit a state dam safety official to participate in the federal inspection of the dam (FEMA).

Also under the National Dam Safety Program Act, the federal Interagency Committee on Dam Safety has issued a series of guideline documents on dam safety:

- Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners
- Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams
- Federal Guidelines for Dam Safety: Earthquake Analyses and Design of Dams
- Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams
- Federal Guidelines for Dam Safety: Glossary of Terms

The guideline on Inflow Design Floods (IDFs) relates to the issue of accommodating flood control failures upstream. The IDF is the flood flow above which the incremental increase in water surface elevation downstream due to failure of a dam or other water retaining structure is no longer considered to present an unacceptable additional downstream threat.

Today, all states except Alabama and Delaware have dam safety regulatory programs. State governments have regulatory responsibility for 95% of the approximately 78,000 dams within the National Inventory of Dams. These programs vary in authority but, typically, the program activities include (1) safety evaluations of existing dams, (2) review of plans and specifications for dam construction and major repair work, (3) periodic inspections of construction work on new and existing dams, and (4) review and approval of emergency action plans (ASDSO).

## COMMON HYDROELECTRIC FACILITY VULNERABILITIES

*Critical infrastructures and key assets vary in many characteristics and practices relevant to specifying vulnerabilities. There is no universal list of vulnerabilities that applies to all assets of a particular type within an infrastructure category. Instead, a list of common vulnerabilities has been prepared, based on experience and observation. These vulnerabilities should be interpreted as possible vulnerabilities and not as applying to each and every individual facility or asset.*

The following is a list of common vulnerabilities found in hydroelectric facilities.

| **Exhibit 1 Economic and Institutional Vulnerabilities** | |
|---|---|
| *Economic and institutional vulnerabilities are those that would have extensive national, regional, industry-wide consequences if exploited by a terrorist attack.* | |
| 1 | Loss of electric generating capacity could stress the regional power grid. This could ripple down and affect the electricity-dependent economy of an entire region. |
| 2 | Downstream flooding from the breaching of a dam could result in extensive casualties and property damage. Large areas may be affected by destruction of a dam. Significant economic impacts may be experienced, including loss of tax revenue to affected local governments. |
| 3 | Loss of control of water supply from damage or destruction of a dam could have significant impact on agriculture, river navigation, and municipal water supply. |

| **Exhibit 2 Site-Related Vulnerabilities** | |
|---|---|
| *Site-related vulnerabilities are conditions or situations existing at a particular site or facility that could be exploited by a terrorist or terrorist group to do economic, physical, or bodily harm or to disable or disrupt facility operations or other critical infrastructures.* | |
| **Access and Access Control** | |
| 1 | Facilities typically experience large numbers of visitors due to associated water-based recreation and, in some cases, the facility's status as a tourist attraction. |
| 2 | Facilities are typically accessible by road and larger facilities often have a road along the top, allowing possible vehicle-based attack. Vehicle barriers may not be in place. |
| 3 | Facilities are typically accessible by water, allowing possible boat-based attack. |
| 4 | Access to key assets such as control rooms, powerhouses and transmission equipment is generally controlled through gates, doors and fences; some of these barriers may need to be upgraded. |
| 5 | Critical assets such as control areas may be close to the perimeter fence, allowing for a successful attack from outside the fence line. |
| | *(Continued on next page.)* |

| | |
|---|---|
| 6 | Critical assets such as transformer units may be exposed or out in the open. |
| 7 | Facilities may be unguarded or have unarmed security guards. |
| 8 | Access controls based on cards or badges do not positively identify the user; thus a stolen badge might be used. |
| 9 | Employee and visitor parking may be located adjacent to critical buildings. |
| 10 | Lighting and monitoring of entrance points may be limited. |
| 11 | Systems and alarms to detect intrusion into restricted areas (including water areas) may be limited. |
| **Operational Security** | |
| 12 | Limited background checks are typically conducted on employees and contractor personnel. Background checks may be limited to security personnel only. |
| 13 | There is limited coordination with local, state, and federal agencies on roles/responsibilities for security. |
| 14 | Detailed information on facility locations, critical assets, maps, and other operational data is available in open literature and on the Internet. |
| 15 | Procedures may not be in place for inspection of deliveries. |
| **SCADA and Process Control** | |
| 16 | Security may be lacking around servers and control rooms. |
| 17 | There is a potential for intruders to hack into SCADA process control through an enterprise network. |
| 18 | An operator could potentially cause an undesirable event. |
| 19 | A disgruntled employee could alter data or algorithms used to control the system. |
| **Emergency Planning and Preparedness** | |
| 20 | Some facilities are in remote locations, leading to relatively long response times for emergency response and law enforcement agencies. |
| 21 | Coordination of emergency plans with local, state, and federal government may be inadequate. At federal facilities, authority for local agency response should be clarified with interagency agreements and regular exercises. |
| 22 | Spare parts that are large and/or expensive are in short supply. Economic considerations have reduced these spare part inventories. Some parts have long manufacturing lead times. |
| **Other System Operation Considerations** | |
| 23 | The increased use of information management systems could cause potential vulnerabilities through a cyber attack. |
| 24 | Failure of the flood control mission at one dam may lead to failure at downstream facilities. |

| **Exhibit 3 Interdependent Vulnerabilities** | |
|---|---|
| *Interdependency is the relationship between two or more infrastructures by which the condition or functionality of each infrastructure is affected by the condition or functionality of the other(s). Interdependencies can be physical, geographic, logical, or information-based.* | |
| **General** | |
| 1 | Failure of the flood control mission at one dam may lead to failure at downstream facilities. |
| **Natural Gas/Petroleum Products** | |
| 2 | Many facilities have backup diesel generators that rely on delivered fuel. |
| **Transportation** | |
| 3 | Maintenance and repair of hydroelectric facilities requires the movement of personnel, equipment, and often heavy-duty vehicles (e.g., cranes) over distances that can be significant. |
| 4 | Some hydroelectric facilities have public roads across them. |
| **Electric Power** | |
| 5 | Electric power is needed for SCADA and water control system operation. |
| 6 | Larger facilities generally have water-powered generators devoted to internal electricity supply, known as “Station Service Units,” with diesel backup. Switching and transformers associated with station service units may be exposed and vulnerable. |
| **Telecommunication** | |
| 7 | Due to the size and remoteness of hydroelectric facilities, telecommunications is important to security. Mobile telecommunications are needed for communications between security units; for example, between a gate guard and the control room. |
| 8 | The ability to call for outside help over multiple channels is needed. The facility should not be solely reliant on publicly switched landlines or cells. Also, multiple radio frequencies may be needed for communication with local police versus federal agencies (e.g., park rangers). |
| 9 | Internal and external telecommunications are essential to operation of SCADA systems. Data is needed on the prevalence of backup systems and systems that do not depend on publicly switched networks. |

# Notation

| | |
|---|---|
| ASDSO | Association of State Dam Safety Organizations |
| FERC | Federal Energy Regulatory Commission |
| GW | Gigawatt(s) |
| IDF | Inflow Design Flood |
| MW | Megawatt(s) |
| SCADA | Supervisory Control and Data Acquisition |
| TVA | Tennessee Valley Authority |
| USBR | United States Department of the Interior, Bureau of Reclamation |
| USACE | United States Army Corps of Engineers |
| USSD | United States Society for Dams |

## USEFUL REFERENCE MATERIAL

Association of State Dam Safety Officials (ASDSO) [http://www.damsafety.org].

Congressional Research Service, 2002, *Terrorism and Security Issues Facing the Water Infrastructure Sector* [http://carper.senate.gov/acrobat%20files/RS21026.pdf].

Federal Energy Regulatory Commission (FERC), hydropower page [http://www.ferc.gov/industries/hydropower/gen-info.asp].

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U.S. Army Corps of Engineers [http://www.usace.army.mil].

U.S. Army Corps of Engineers Hydroelectric Design Center [https://www.nwp.usace.army.mil/hdc/].

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U.S. Energy Information Administration [http://www.eia.doe.gov/cneaf/electricity/page/pubs.html].

United States Society on Dams [http://www.ussdams.org/uscold_s.html].

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